**MAPPING IRON DISTRIBUTION IN THE LUNAR CRUST, PART 1: ESTABLISHING THE RELATIONSHIP BETWEEN CHEMICAL AND MINERALOGICAL IRON ABUNDANCES AND ALBEDO**; P.E. Clark (Catholic University of America), Code 691, NASA/GSFC, Greenbelt, MD 20771 and L.A. McFadden, Astronomy Department, University of Maryland, College Park, MD

Although maps of lunar iron abundance determined from orbital measurements of Apollo Gamma-ray (AGR) data (1), which had limited (20%) spatial coverage of the surface, and modeled from Clementine spectral reflectance (CSR) data (2), which had nearly global coverage, both show a bimodal iron distribution, they also exhibit discrepancies in modal averages and regional varations in iron. The relationship between these datasets (special filters have been applied to Clementine data to simulate the lower spatial resolution of Apollo data), as well as albedo varations (CAL) (3), which affect spectral reflectance measurements, must be examined globally on a pixel by pixel basis in order to produce a properly calibrated lunar iron map. These datasets are being quantitatively compared to each other as well as to ground truth from samples and geological maps, in an attempt to produce a carefully calibrated iron abundance map which is global in extent.

In terms of general comparisons, where error bars for both datasets are approximately plus or minus 1 to 2%, the averages for iron are 4% for CSR data, as opposed to 5 to 6% for AGR data for the lower iron mode, and 9 to 10% for AGR data as opposed to 13% for CSR data for the higher iron mode. AGR data show more variation in all terrains, which will be explored below.

In the farside highlands, the presence of basins is always correlated with varations of a few percent in iron on the AGR map (4). These variations generally do not appear at all on the CSR map, probably the most striking difference between two maps. Perhaps this difference can be explained by a lack of variation in iron in pyroxene. Iron would have to be present in that mineral to be observed in the pyroxene band that appears in spectral reflectance observations. Surpression may be caused by an albedo effect, as discussed below. The AGR mare iron values are far more variable as well, consistent with the variations reported in mare soil and rock samples (4,5). Unfortunately, the AGR global iron map, which apparently more accurately reflects iron abundance, is far more limited in coverage.

**TABLE 1: FARSIDE COMPARISON OF IRON ABUNDANCE AND ALBEDO**

| | AGR | CSR | CAL |
|---|---|---|---|
| **REGION AVERAGES** | | | |
| Northeast Side | 5% | 3% | 0.4 |
| Southeast Side | 6% | 4% | 0.4 |
| Southwest Side | 4% | 3% | 0.45 |
| Northwest Side | 6% | 3% | 0.35 |
| Van De Graaf | 8% | 7% | 0.3 |
| **REPRESENTATIVE POINT VALUES** | | | |
| Pasteur | 7% | 3% | 0.36 |
| Tsiolkovsky | 8% | 6% | 0.35 |
| Mendeleev | 7% | 2% | 0.42 |
| Pavlov | 7% | 3% | 0.42 |
| Wendelshtam | 6% | 2% | 0.43 |
| Tsander | 8% | 3% | 0.43 |
| Hertzsprung | 4% | 2% | 0.47 |
| Einstein | 5% | 2% | 0.44 |
| Schlurer | 7% | 3% | 0.40 |
| Hedin | 8% | 4% | 0.43 |

**TABLE 2 NEARSIDE COMPARISON OF IRON ABUNDANCE AND ALBEDO**

| | AGR | CSR | CAL |
|---|---|---|---|
| **REGION AVERAGES** | | | |
| Imbrium/Procellarum | 11% | 14% | 0.2 |
| Serenitatis | 11% | 13% | 0.2 |
| Tranquillitatis | 9% | 12% | 0.17 |
| Fecunditatis | 10% | 12% | 0.22 |
| Crisium | 9% | 11% | 0.22 |
| Smythii | 7% | 9% | 0.25 |
| **REPRESENTATIVE POINT VALUES** | | | |
| Procellarum | 14% | 14% | 0.17 |
| Serenitatis | 11% | 13% | 0.17 |
| Fecunditatis | 12% | 12% | 0.22 |
| Smythii | 8% | 9% | 0.26 |
| Nectaris | 13% | 12% | 0.24 |

**TABLE 3 LANDING SITE COMPARISON OF IRON ABUNDANCES**

| SITE | AGR | CSR | SOIL AVERAGE |
|---|---|---|---|
| Apollo 12 | 12% | 14% | 12% |
| Apollo 14 | 8% | 11% | 8% |
| Apollo 15 | 9% | 9% | 9% |
| Apollo 16 | 4% | 3% | 4% |
| Apollo 17 | 10% | 10% | 9% |

These tables illustrate that a clear inverse relationship exists between albedo and variations in the CSR derived iron: where albedo is high, the CSR values are lower, and vice versa. Previous work (5) has demonstrated that soils with very different optical properties do not show the same relationship between the depth of the iron band and iron abundance. Other work has demonstrated that anomalies in an otherwise good correlation between albedo and chemical composition occur in localities with differences in soil morphology which affect optical scattering properties (6). We propose that attempts to remove varation in maturity from CSR data, involving the systematic use of reflectance at 750 nm, has resulted in systematic underestimating of iron abundance in highland soils, where greater comminution and roughness is present on all size scales and albedo is higher, and overestimating of iron in mare soils, which have more opaques and lower albedo.

**REFERENCES:** (1) Davis (1980) JGR 85, 3209-3224; (2) Lucey, Taylor, Malaret (1995) SCINCE 268, 1150-1153; (3) McEwen, Personal Communication, 1996; (4) Clark, McFadden (1996) LPS XXVII, 227-228; (5) Clark, Hawke, Basu (1990) PROC LPSC 20, 147-160; (5) Clark, Andre, Adler, Podwysocki, Weidner (1976) GRL 3, 8, 421-424; (6) Fischer, Pieters (1994) ICARUS, 111, 475-488.